Cree Lake Aquatic Vegetation Management Plan Prepared for the Cree Lake Association

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Funded by the Lake and River Enhancement (LARE) program and the Cree Lake Association.

Executive Summary

Aquatic Weed Control was contracted by Cree Lake Association to develop a long term lake wide management plan. Funding for this plan was provided by the Cree Lake Association and the Department of Natural Resources Division of Soil Conservation. This funding is awarded through the Lake and River Enhancement (LARE) program. Aquatic Weed Control conducted two aquatic vegetation surveys to characterize the plant community of Cree Lake. Following protocol established by the Indiana Department of Natural Resources, a qualitative survey called the Tier I reconnaissance survey was used to obtain an understanding of the vegetation present in Cree Lake. Next, a quantitative survey (Tier II) was used to document the distribution and abundances of individual plant species in Cree Lake.

Cree Lake has nuisance aquatic vegetation that causes problems with fishing, swimming, boating and the overall use of the lake by residents and non-residents. The vast majority of these vegetation problems stem from the overabundance of two native aquatic plants: chara and coontail. LARE funding is available for the control of exotic weed species only, and since chara and coontail are not exotic species, all management of these species will have to be privately funded.

The action plan will be divided into two phases. The most significant problem in the main lake is the growth of chara. Lake residents should meet before May of 2005 to sign up for treatments of individual lots. These treatments will temporarily control chara and allow residents greater access to the lake. Each treatment will cost approximately 250 to 300 dollars. Since a contact herbicide will be used. Re-growth will occur later in the season and additional treatments may be requested.

The main problem in the channels adjacent to Cree Lake is the overabundance of coontail. This significantly inhibits boat traffic and access to the main lake for residents living along the channels. Two chemical treatments would be needed to control the vegetation in the channels. Each of these treatments would cost 3,300 dollars.

In addition to controlling the native species, the lake association should keep a watchful eye for exotic plant species. Curly leaf pondweed, an invasive species, was found in extremely small quantities in surveys conducted by Aquatic Weed Control and the IDNR. Should this species or another exotic plant begin to proliferate in the lake, it should be addressed immediately.

Acknowledgements

Aquatic vegetation surveys conducted on Cree Lake were made possible by funding from the Indiana Department of Natural Resources and the Cree Lake Association. Aquatic Weed Control would like to extend special thanks to Indiana Department of Natural Resources (IDNR) District 3 biologist Jed Pearson for providing procedural training for the Tier I and Tier II aquatic vegetation surveys. Jed Pearson also provided assistance and consultation in generating plant distribution maps for Cree Lake. Cecil Rich, aquatic biologist for the IDNR Division of Soil Conservation, provided valuable consultation regarding the requirements and objectives of this lake management plan. Jed Pearson and Cecil Rich both reviewed this management plan and provided suggestions for revision. Also, special thanks to Brad Fink, assistant fisheries biologist for the IDNR, for providing training in data analysis programs for the Tier II quantitative vegetation surveys. Jason Doll of the IDNR also provided assistance in generating data analysis reports for the Tier II survey data. Jim Donahoe and David Keister of Aquatic Weed Control conducted the aquatic vegetation sampling and are the authors of this report. Aquatic Weed Control would also like to thank the members of the Cree Lake Association for their commitment to improving this lake and for valuable discussion and input brought forward at the informational meeting held on November 30, 2004.

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Introduction

Aquatic Weed Control was contracted by Cree Lake Association to develop a long term lake management plan. Funding for this plan was provided by the Cree Lake Association and the Department of Natural Resources Division of Soil Conservation. This funding was part of the Lake and River Enhancement (LARE). The survey and management plan are required to receive LARE funding to treat the lake for nuisance aquatic vegetation.

When a person registers a boat within the state of Indiana a lake enhancement fee is included in the cost of registry. One third of this money is then used to provide funding for projects designed to improve the quality of Indiana lakes by controlling invasive plant species. These surveys included in this report, as well as the management plan, are required by the state to receive additional funding to treat the lake for exotic aquatic vegetation. Should a lake be selected for LARE funding, up to 100,000 dollars can be given for a whole-lake treatment with a cumulative 3-year maintenance total of an additional 20,000 dollars. If the whole lake is not treated, up to 20,000 dollars can be available annually for up to three years. Requests for funding are reviewed by the Indiana Soil Conservation Board, and funds will be distributed at their discretion.

Problem Statement

Cree Lake, located in northeast Noble County, is in need of intervention to maintain a healthy and diverse plant community while providing a level of control that will benefit both the lake ecosystem and stakeholders wishing to enjoy the lake.

An abundance of aquatic plants, including small areas of the invasive curly leaf pondweed, blanket the littoral zone of this lake, making it nearly impossible for many lake residents to take part in activities such as swimming, fishing, and boating. Aquatic vegetation is essential to promoting a healthy lake ecosystem, but in the case of Cree Lake, the proliferation of these aquatic species has significantly reduced the utility of this lake and may also contribute to ecological problems (Kalff, 2000).

The channels adjacent to Cree Lake on its east side are of special concern. Although the channels are man-made, they still have a direct impact upon the lake ecosystem, and they also provide additional access to the lake for many nearby residents. These channels become choked with weeds each spring, making boat access very difficult and possibly even contributing to fish stunting.

In the past all chemical control was carried out based on requests of individual lake residents. Chara was the main problem on the main lake while coontail was very abundant in the channels adjacent to the lake. Cree Lake is in need of a management strategy that will protect native aquatic vegetation and provide a reasonable level of usability for both lake residents and the general public. In the past, individuals owning lake front property could pay to have specific areas chemically treated to provide better access to the lake. This plan will outline how effective control of native plants is possible without eradicating them completely.

Management Goals:

The following management goals have been established by the IDNR for all lakes applying for LARE funding.

1. Develop or maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality and is resistant to minor habitat disturbances and invasive species.

2. Direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species.

3. Provide reasonable public recreational access while minimizing the negative impacts on plant and wildlife resources.

Specific Objectives

1. **Problem areas of the main lake will be treated with contact herbicides in mid-May**. Since the plants causing problems in Cree Lake are natives, contact chemicals are recommended because they will not kill the roots of the plants. Unfortunately, re-growth of these plants will occur later in the summer.

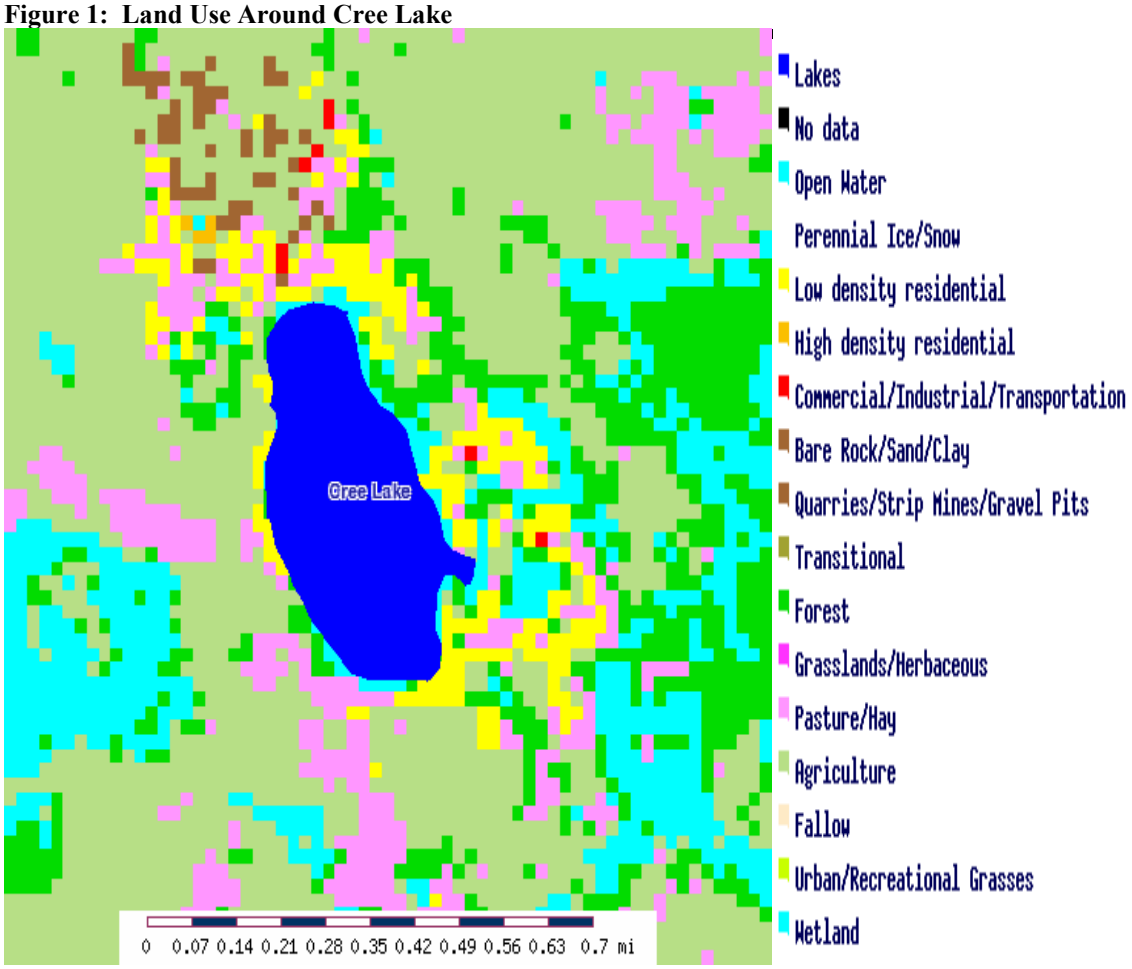
2. **The channels of Cree Lake should be treated before June 1**. Again, the majority of plants present in the channels are native, and contact herbicides should be used to insure that the natives are not completely eradicated.

In the past, the lake was treated sporadically with contact herbicides to provide temporary relief from the overabundance of aquatic vegetation. It has become clear that more treatment is necessary to provide an adequate level of control. Reducing plant beds in more areas of the lake should provide this control, and weed beds not inhibiting lake access can be left to maintain healthy levels of vegetation growth.

Watershed and Water Body Characteristics

Cree Lake, located in northeastern Noble County has 76 surface acres with a maximum depth of 26 feet and an average depth of 15.7 feet. The watershed of this moderately productive lake is used primarily for agricultural purposes. Nearly 95% of the shoreline of Cree Lake is developed, while only 5% of the shoreline is bordered by wetlands. During the summer months, oxygen levels sufficient for fish life are only present to 15 feet. According to the IDNR, water quality has improved since the 1970's, with secchi disk readings now fluctuating between 5.0 to 9.0 feet (Tyllia, 2000). Figure 1 shows the land use in the watershed next to Cree Lake.

Figure 1: Land Use Around Cree Lake



Cree Lake Fisheries

The following fisheries survey was conducted by The Indiana Department of Natural Resources and took place on July 24, 1991. Data was obtained by using electro-fishing and gill nets to collect, count, measure, and then release fish. A total of 18 species of fish were collected, many of which were valuable game fish.

Bluegills were the most abundant species in the 1991 survey, accounting for 61.9 percent of the population. Bluegill size was average to below average, with few fish above 8 inches being collected. However, according to the IDNR bluegill size is said to be improving.

Largemouth bass were also very abundant, accounting for 20.7 percent of the total fish population. Only 11 percent of the largemouth bass collected were 12 inches or larger, and the biggest largemouth bass collected in this survey exceeded the legal harvestable length by less than half of an inch. Largemouth bass size distribution in Cree Lake is considered very small compared to other area lakes.

There is no record of fish stocking in Cree Lake, although one hybrid muskellunge was collected in 1991. Many other species of fish are present in small numbers in Cree Lake. There are many members of the sunfish and minnow family, as well as rough fish such as bowfin, spotted gar, and yellow bullhead. A table summarizing Cree Lake fisheries survey results is included below.

Table 1: IDNR Fisheries Survey 7/24/91

Species	Total # Collected	Percentage	Size Range (in.)
Bluegill	485	61.9	1.0-8.5
Largemouth Bass	162	20.7	2.0-14.4
Pumpkinseed	37	4.7	2.7-7.3
Warmouth	22	2.8	2.4-6.7
Yellow Perch	20	2.6	1.9-8.9
White Sucker	14	1.8	7.8-20.0
Yellow Bullhead	14	1.8	8.6-12.5
Golden Shiner	7	0.9	3.6-9.2
Spotted Gar	6	0.8	18.4-30.2
Grass Pickerel	4	0.5	5.0-11.0
Lake Chubsucker	3	0.4	5.8-9.6
Carp	2	0.3	26.0-28.2
Black Crappie	2	0.3	4.8-5.5
Tiger Muskellunge	1	0.1	36.3
Channel Catfish	1	0.1	26.1
Bowfin	1	0.1	24.1
Hybrid Sunfish	1	0.1	5.7
Green Sunfish	1	0.1	3.5

The fish community and the plant community in Cree Lake are closely related. The aquatic plants provide escape cover for young fish, produce oxygen, and they increase the overall biodiversity of the lake helping to create a stable ecosystem. Unfortunately, overabundant coverage of plants can have many adverse effects on the plant community.

Present Water Body Uses

Today, Cree Lake is highly valued to many stakeholders for a number of reasons. This lake has a 10-mile per hour speed limit, which eliminates heavy use by fast moving jet skis and ski boats. This restriction calms the waters of Cree Lake and makes it an ideal place to swim, fish, or take a leisurely boat ride.

Cree Lake has a public access site at its northwest end, along State Road 3. This access site opens this lake to the general public, and its location on a fairly busy highway makes it a popular destination for many people. The 10 mph speed limit makes the lake very attractive to anglers.

Unfortunately, all of the major water body uses are being adversely affected by the incredible amounts of aquatic vegetation that ring the lake and choke the channels. Reducing the weed cover would significantly increase the usability of this lake, and management practices implemented at Cree Lake would benefit thousands of people in the surrounding area, due to the location and accessibility of the lake.

Characterization of the Plant Community

Chara, a native form of algae, grows abundantly in many areas of the littoral zone. This plant forms extremely dense beds that prohibit other plants from gaining the light and nutrients they need to survive (Kannenberg and Schmidt, 1998). Typically, where chara is found in abundance, few or no other plant species will be found. The exclusion of other plants in large beds of Chara is reflected in the data sheets of the Tier II survey and is very visible on a boat-ride around Cree Lake.

Coontail is also abundant, and it is most problematic in the channels adjacent to Cree Lake. This weed is free floating and can spread quickly to new areas, forming dense weed beds (Lembi, 1997). These weed beds can greatly inhibit boat navigation, as the long tree-like plants become entangled in motor propellers. Since the channels were constructed specifically to provide access to the lake, reducing coontail would be essential to providing better accessibility for residents living on the channels.

Cree Lake Tier I Survey Methods

The Tier I reconnaissance survey is designed to identify the major plant beds present in a body of water. This is a qualitative survey designed to give an overview of the aquatic vegetation present in a lake. It identifies and documents problem areas that can be targeted when management practices are implemented. Major submersed plant beds are found visually from a boat. Each bed is given a reference number that is recorded on Tier I data sheets. The general locations of these beds are recorded on a bathymetric map of the lake, and more precise locations are recorded on Tier I data sheets with the help of a WAAS enabled GPS unit.

When a major plant bed is identified, each species of plant found in that bed is recorded. Canopy ratings are given to each plant bed based on the types of plants present in that bed. The four major types of plants to be identified in this study are as follows: submersed plants, emergent plants, non-rooted floating plants and rooted floating plants. The following scale is used to describe these four types of plants based on the percentage of the plant bed canopy they occupy:

Canopy Rating

1 = <2% of canopy
2 = 2-20% of the caopy
3 = 21-60% of the canopy
4 = >60% of canopy

In addition to the canopy rating, another abundance rating is given to each individual species found in a particular plant bed. This abundance rating is based on the percentage

of the entire bed area that species appears to occupy. The scale for this abundance rating is the same as the canopy rating scale. The difference is that this scale identifies the abundance of *individual species* in the bed:

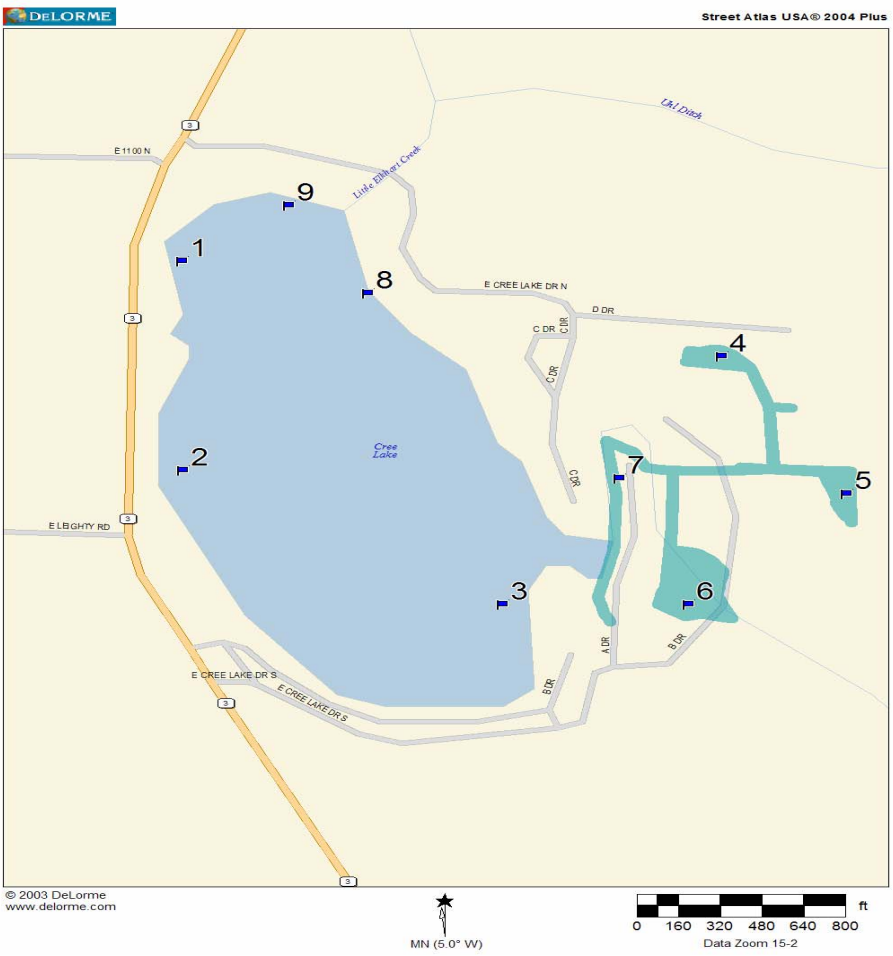
Species Abundance Rating

1 = < 2% of the bed
2 = 2-20% of the bed
3 = 21-60% of the bed
4 = >60% of the bed

Since this is a visual survey, results are dependent upon the surveyor's ability to locate plants below the water's surface. Tier I surveys are much less effective in lakes with low secchi disk readings. Polarized glasses were used to reduce glare from the sun and enable the surveyors to see more easily into the water. Even with the aid of polarized glasses, the Tier I survey should not be considered an exhaustive survey of aquatic vegetation. The Tier I survey is a tool that helps to provide an overall picture of an aquatic plant community when coupled with the Tier II quantitative survey.

During the Tier I survey of Cree Lake nine major plant beds were found. Seven species of aquatic plants were identified, and there abundances at each bed were recorded.

Figure 2: Tier I Plant Bed Locations



Tier I Survey Plant Bed Summary

Plant Bed #1
This plant bed had a size of approximately 2 acres and contained 3 plant species. Illinois pondweed and Eurasian milfoil were both present with abundance ratings of 2, while chara had an abundance rating of 3.

Plant Bed #2
This plant bed had a size of approximately ¼ acre and contained 4 plant species. Sago pondweed, Eurasian milfoil, and eelgrass were all present with abundance ratings of 2. Again, chara was present with an abundance rating of 3.

Plant Bed #3
This was a relatively small plant bed with a size of approximately 1/10 acre. It contained only two plant species. Illinois pondweed was present with an abundance rating of 2, while chara had an abundance rating of 3.

Plant Bed #4
This was a large plant bed with a size of approximately 2 acres. However, it contained only one species of plant. Coontail was the only plant in the bed and had an abundance rating of 3.

Plant Bed #5
This plant bed was approximately 1.5 acres in size and contained only one species as well. Again, coontail was the only species present, and it had an abundance rating of 3.

Plant Bed #6
This plant bed was also 1.5 acres in size and contained two plant species. Coontail was present with an abundance rating of 3 while sago pondweed was present with an abundance rating of only one.

Plant Bed #7
This plant bed had an approximate size of 2 acres and contained two species. Coontail was the dominant plant species again, but had an abundance rating of only two. Illinois pondweed was also present and had an abundance rating of 1.

Plant Bed #8
This plant bed was approximately ¼ acre in size and contained two plant species. Illinois pondweed had an abundance rating of 2, while eelgrass had an abundance rating of 1.

Plant Bed #9
This was a small plant bed at 1/10 acre in size, but it contained five plant species. Curly leaf pondweed, Illinois pondweed, sago pondweed, and coontail were all present with abundance ratings of 2, while eelgrass was present with an abundance rating of 3.

Tier I Survey Summary

The nine major plant beds identified in Cree Lake each contained 1 to 5 plant species and covered over nearly 10 acres of the lake. Chara is known to dominate the lake, and coontail dominated all the beds that did not contain chara. Eelgrass and sago pondweed both had moderate occurrence and abundance ratings. Curly leaf pondweed occurred less frequently than the other weeds and had a moderate average abundance score (2.0).

The results of the Tier I visual survey were very similar to the results of the Tier II quantitative survey. Secchi depth readings were considered low compared to area lakes. Poor water clarity makes many weeds difficult or even impossible to see from above the water's surface. Decreased visibility can make Tier I surveys very challenging, but when coupled with the Tier II quantitative survey, these tools can provide an accurate description of the aquatic plant community of a lake.

Materials and Methods: Tier II Random Sampling

Summary

A Tier II quantitative survey of Cree Lake was conducted on August 26, 2004. The purpose of this survey was to document the distribution and abundance of submersed and floating-leaved aquatic vegetation throughout the lake (IDNR, 2004). A specific number of sample sites were selected based on the amount of surface acreage the lake possessed. Once sample sites were determined, sampling was accomplished using an aquatic vegetation sampling rake constructed according to the guidelines of the 2004 Tier II random sampling procedure manual.

Aquatic vegetation collected at each sample site was sorted according to species, and given a value to represent its abundance at that site. These values were immediately recorded on data sheets distributed by the IDNR. These records were used for data analysis that served to characterize the aquatic vegetation community of Cree Lake.

Random Sampling

The IDNR issued the following chart to help determine the number of sample sites needed to accurately describe the aquatic plant community in a lake.

Table 2: Number Sample Sites Based on Lake Size

Size of Waterbody	Number of Sample Sites
1-100 acres	40
101-300 acres	60
Greater than 300 acres	Add 10 sites/100 acres

Based on Cree Lake's 76 surface acres, 40 sample sites were accurately needed to describe this plant community. Aerial photographs and bathymetric maps were used to evenly space 60 sample sites throughout the lake. The littoral zone of the lake was divided into four quadrants of equal length. During the vegetation collection process, an effort was made to collect plants from 15 sites in each quadrant to ensure that the entire littoral zone was surveyed adequately and that random sample sites distributed evenly throughout the lake.

When sampling the littoral zone of the lake. A pattern was used that also helped to ensure an accurate description of the plant community. The littoral zone was divided into three sections based on depth and sample sites alternated between each of these three zones. For example, collection site 1 would be taken in shallow water very close to shore. Collection site 2 would be taken further down the shoreline, but in slightly deeper water. Collection site 3 would be taken further down the shoreline, but in even deeper water, close to the border of the littoral and pelagic (open water) zone. This sampling strategy was recommended by District 3 fisheries biologist Jed Pearson. This strategy not only helps to accurately describe the plants in the littoral zone, but it also aids in determining the maximum depth at which plant can grow in particular lake.

Aquatic Vegetation Sampling Rake

A double-headed garden rake was used to sample aquatic vegetation. This rake design is approved and used by IDNR fisheries biologists in vegetation surveys on many Indiana lakes. It consists of two garden rake heads welded together back to back so that rake teeth are protruding from two sides. The dimensions of the rake are to be 13.5 inches wide with 2.25-inch long teeth spaced 0.75 inches apart (IDNR, 2004).

Each tooth on the rake head is divided into five equal sections and marked accordingly. These marks on the rake teeth are used to estimate the abundance of plant species when they are collected.

A nylon rope is then attached to the rake head. A black permanent marker is used to mark the rope in foot long increments. A red mark is placed every five feet along the rope. This rope is used to measure the depth at each sample site when the rake is lowered to the lake bottom.

GPS and Mapping

A WAAS enabled GPS unit was used to obtain and record the coordinates of each sample site on the lake. A WAAS enabled GPS unit is accurate to within 3 meters and was recommended by aquatic biologist Cecil Rich to obtain maximum accuracy for mapping sample sites. All GPS coordinates were then used to produce computer generated maps of the lake with each sample site labeled on the map. A spreadsheet corresponding to this map is included in this report. The species and abundances at each sample site can be found using the labeled sample sites and the spreadsheet.

Sampling Procedure

A two-person crew accomplished Tier II aquatic vegetation sampling by boat. A crew leader was responsible for driving the boat to each sample site and recording vegetation data on record sheets issued by the IDNR. An assistant was responsible for collecting the aquatic plants using the double-headed rake.

When a sample site was reached, its GPS coordinates were obtained and recorded. The boat was then brought to a complete stop and the double-headed rake was lowered to the bottom of the lake. The boat was held stationary while the water depth at the sample site was obtained by using the marked rope attached to the rake.

When water depth had been recorded, the crew leader slowly backed the boat away from the rake as the assistant simultaneously let out another ten feet of rope. During this process the rake did not move from the lake bottom.

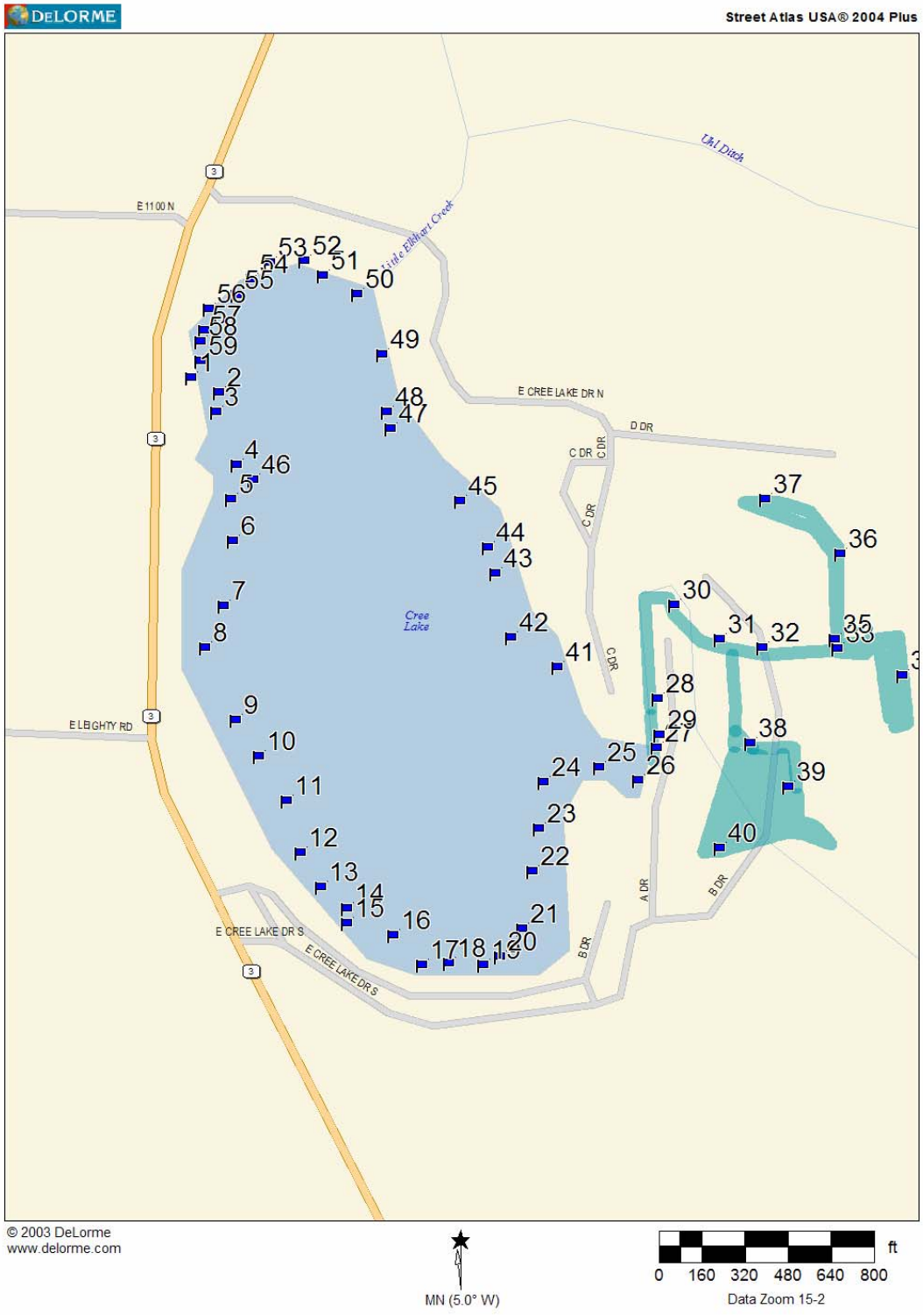
The rake was pulled from the water after the boat had reached the end of the ten extra feet of rope let out after the depth was recorded. This ensured that the rake was pulled horizontally through the water, giving it a greater chance of collecting weeds than if the rake had been lowered to the bottom and raised vertically. The vegetation caught on the teeth of the rake was then gathered into the boat.

Determining Vegetation Abundance

At each sample site, every plant species collected on the rake was scored according to its abundance. This was accomplished by removing all plants from the rake and sorting them by species. Once all plants had been sorted, they were placed back onto the rake and evenly distributed across the marks on the rake teeth. If a species filled the rake to the first mark on the teeth, that species was given a score of one on the abundance data sheet. If it filled the rake teeth to the second mark, it was given a score of two, and so on to a maximum abundance of five.

In many instances it was not necessary to place each species back onto the rake. Many species would fill the rake completely (an abundance of 5) and some species would only have one plant on the rake (an abundance of 1). In addition to abundance scores for individual species, each rake toss was given an overall abundance score, describing how much total vegetation was collected on the rake.

Figure 3: All Tier II Sample Sites



Secchi depth was taken prior to the survey and determined to be approximately 2.5 feet. A total of seven species of aquatic plants were collected during the Tier II survey. Of these species, one of them (curly leaf pondweed) was exotic species. The average number of total species collected at each sample site was 2.21 while the average number of native species collected at each site was 2.03. The species diversity index for Cree Lake was 0.68 while the native plant diversity index was 0.62. Average rake density was 4.39 while average rake diversity was 0.51. The diversity index of native plants collected on the rake was 0.48.

Chara and coontail had the highest average densities at 5.88, and 5.82 respectively, while chara had the greatest relative density at 4.29. The most dominant plant in this survey was chara with a dominance index of 85.8. The next most dominant plant was coontail with a dominance index of only 24.7

Cree Lake Tier II Survey Summary

August 26, 2004

Total # of sample sites: 60
Total # of species: 7

Species List

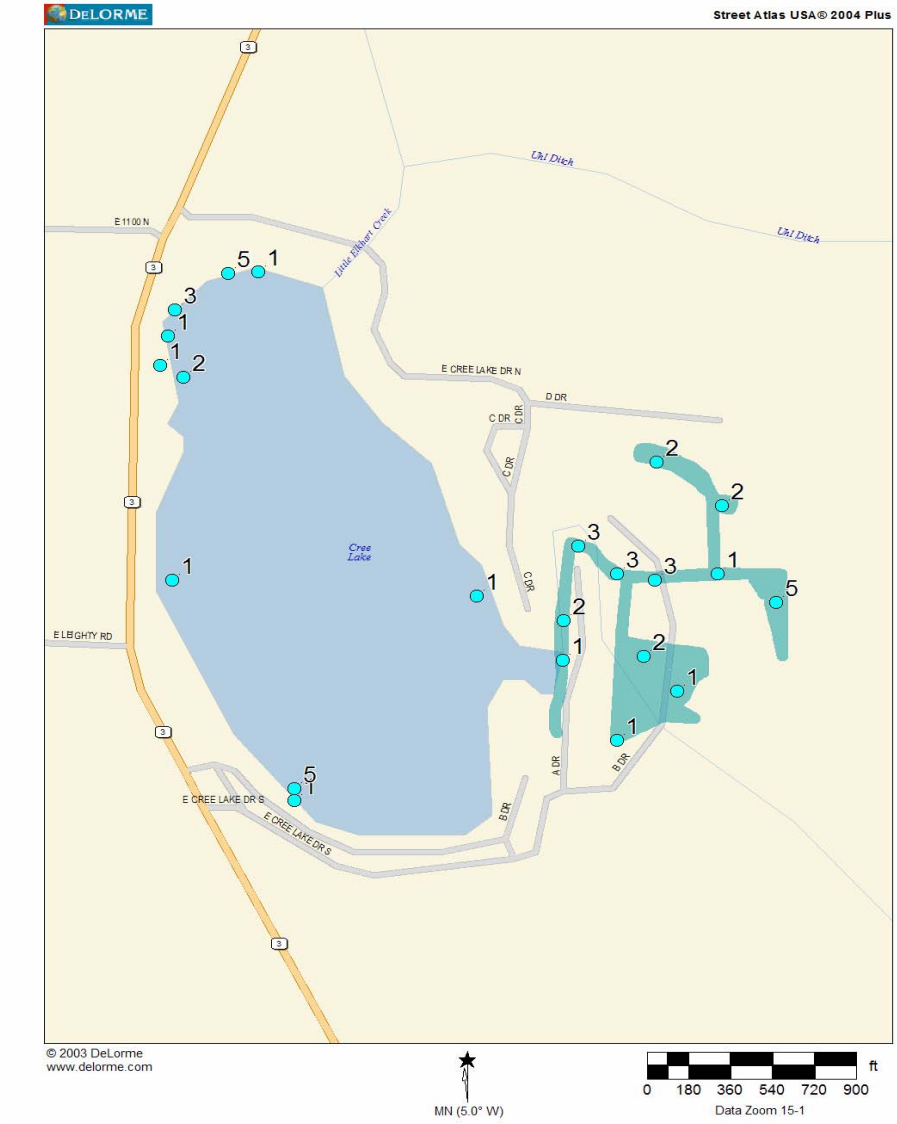
Chara
Coontail
Naiad
Curly Leaf Pondweed
Illinois Pondweed
Eel Grass
Sago Pondweed

Table 3: Tier II Survey Results Summarized

Species	# Of Sites Present out of 60 total sites	Average Abundance
Chara	37	4.43
Coontail	22	2.14
Naiad	7	1.74
Curly Leaf	6	1.00
Illinois Pondweed	4	1.00
Eel Grass	4	2.00
Sago Pondweed	3	1.33

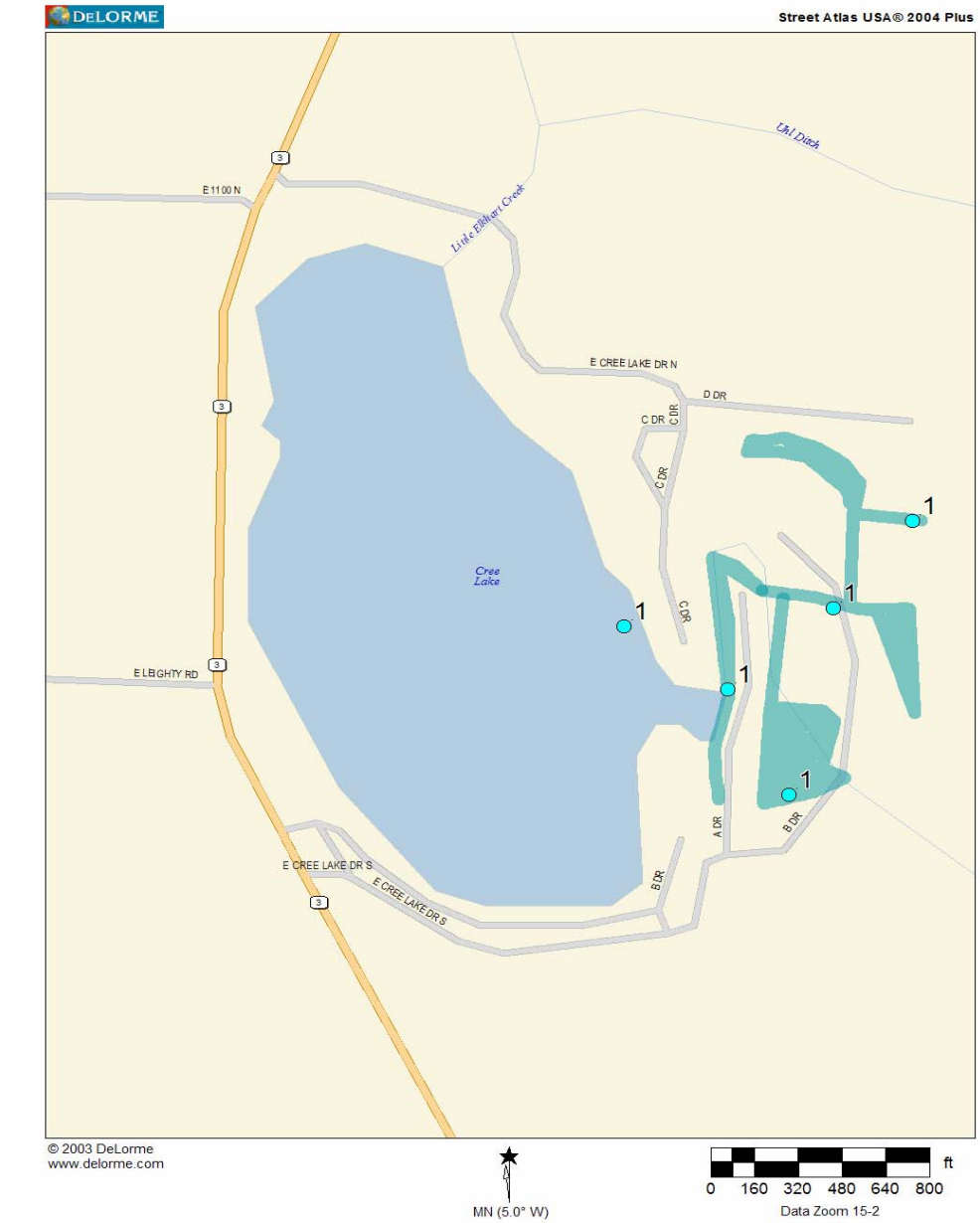
The following maps represent locations where major species of plants were collected during the Tier II vegetation survey. Channels adjacent to the main lake were not available for mapping and had to be drawn in when a sample site was located in a channel.

Figure 4: Sites Where Coontail was Collected



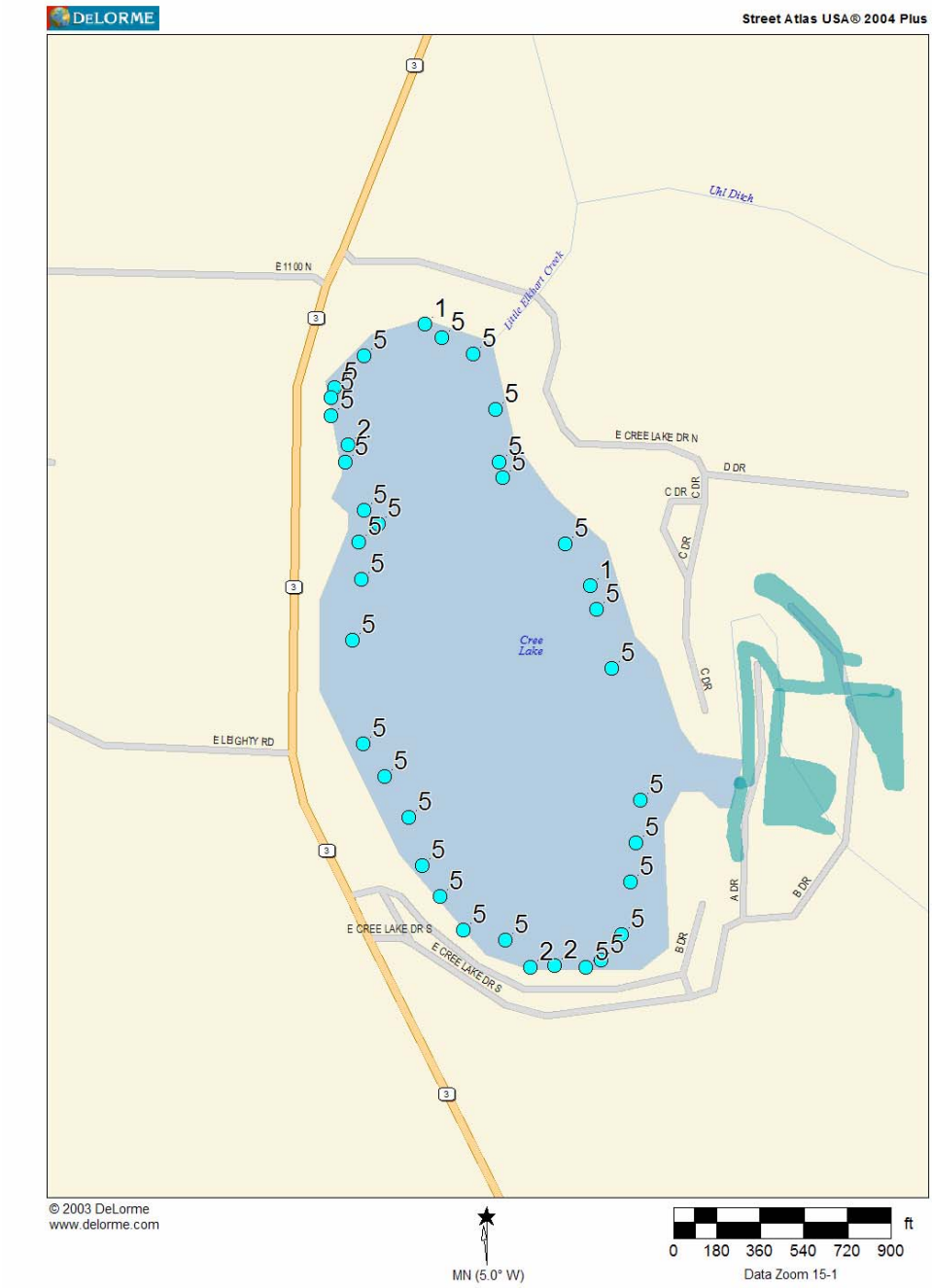
Coontail had a dominance index of 24.7 and was widely distributed throughout the lake. It was especially abundant in the channel areas, and in the northwest corner of the lake.

Figure 5: Sites Where Curly Leaf Pondweed was Collected



Curly leaf pondweed is an invasive species and was found at 5 sample sites in the Tier II Survey. Four of the 5 sites where it was collected were located in the channels adjacent to Cree Lake.

Figure 6: Sites Where Chara was Collected



Chara was the most dominant plant collected in the Tier II survey with a dominance index of 85.8. It was extremely abundant in all areas of the main lake, but was absent from the channel areas.

Species Diversity and Species Dominance

Two of the most important values in table 8 are the diversity indices and the species dominance values. A species diversity index is actually measured as a value of uncertainty (H). If a species is chosen at random from a collection containing a certain number of species, the diversity index (H) is the probability that the chosen species will be different from the previous random selection. The diversity index (H) will always be between 0 and 1. The higher the H value, the more likely it is that the next species chosen from the collection at random will be different from the previous selection (Smith, 2001). This index is dependent upon species richness and species evenness, meaning that species diversity is a function of how many different species are present and how evenly they are spread throughout the ecosystem.

Species dominance is dependent upon how many times a species occurs, and its relative coverage area or biomass within the system. In this survey, the abundance rating given to each species at each sample site was used to determine dominance. The dominance of a particular species in this Tier II survey increases as its site frequency and relative abundance increase.

Table 4: Tier II Data Analysis

Occurrence and Abundance of Submersed Aquatic Plants

Date:	8/26/04	Littoral sites with plants:	38	Species diversity:	0.68
Littoral depth (ft):	5.0	Number of species:	7	Native diversity:	0.62
Littoral sites:	38	Maximum species/site:	5	Rake diversity:	0.51
Total sites:	59	Mean number species/site:	2.21	Native rake diversity:	0.48
Secchi:	2.5	Mean native species/site:	2.03	Mean rake score:	4.39

Common Name	Site frequency	Relative density	Mean density	Dominance
Chara	73.7	4.29	5.82	85.8
Coontail	21.1	1.24	5.88	24.7
Curly-leaf Pondweed	13.2	0.16	1.20	3.2
Eel Grass	7.9	0.21	2.67	4.2
Illinois Pondweed	5.3	0.08	1.50	1.6
Sago Pondweed	5.3	0.11	2.00	2.1
Naiad sp	15.8	0.32	2.00	6.3

Comparison with IDNR Survey Results

A Tier II vegetation survey was conducted on July 27, 2004 by the IDNR. Results are very similar to Aquatic Weed Control's survey, which is to be expected given that both surveys took place in later summer, when aquatic weed growth is abundant. Plant species diversity calculated by Aquatic Weed Control was 0.68 while the plant diversity calculated by the IDNR in July was 0.70. Native diversity in Aquatic Weed Control's survey was 0.62 while in the IDNR's survey it was 0.68. Rake diversity calculated at the end of August by Aquatic Weed Control was 0.51, while the diversity index in July was slightly higher at 0.61. The largest variation between surveys was in native rake diversity. In August, this value was 0.48, while in July, it was 0.61.

In both surveys, chara and coontail were by far the most dominant plants in Cree Lake. Dominance values of coontail were extremely similar in both surveys (32.4 and 24.7) while chara dominance showed much more variation (41.2 and 85.8). Other plant species such as eelgrass, naiad and curly leaf pondweed were present in both surveys with very low dominance ratings.

Threatened and Endangered Species

No threatened or endangered species were found during the Tier I or the Tier II survey. The improving water quality of Cree Lake has been encouraging, and could make the lake more conducive to the growth of fragile species. However, with the overabundance of vegetation in Cree Lake, it is doubtful that any threatened species would be able to gain a foothold.

Aquatic Management and Action Plan

As stated previously in this report the native weed species that are present in the lake are not covered under the LARE funding program. Unfortunately, any treatment on the lake will have to be done with private funds. The association should try to put a program together to address the native weed species that are choking the lake. Native weed species are best controlled with contact herbicides because they do not kill the roots of the plants. Chara, the most abundant plant in Cree Lake, is which is actually an alga. To achieve the best control it needs to be treated in mid-May before the plant calcifies. If the plant calcifies prior to treatment it will be difficult to control since the calcium will prevent the chemical from being absorbed by the plant. Also, since we are only using contact herbicides the chara will re-grow within the same season.

It is recommended that the association have a meeting early in the year to sign up lake residents who wish to have their lake frontages treated for the control of chara. Cost would be $250.00 to $300.00 per application for each lake-front lot. Aquatic Weed Control would attend the meeting and give flags to these residents. These flags would then be used to mark the properties that the residents desire to have sprayed.

Channel Action Plan

The series of channels of the east side of Cree Lake becomes almost completely weed choked every year if left untreated. These channels would be best sprayed with contact herbicides to make the channels navigable. Since contact chemical are being used, more than one application would be needed to achieve full season control since contact herbicides do not kill the roots of aquatic plants. If two applications were conducted, the first would take place in May and the second in early June. Each of these applications would cost approximately $3300.00. Contact herbicides will only control the weeds that are present at the time of application.

Should the association choose to treat the channel only once, mid to late June would be the most effective time to treat. Coontail does not achieve full growth until about June 15. It is important to note that the action plan for both the main lake and the channels falls within the current level of control permitted by the IDNR (6ac/yr).

It is also recommended that the association have a meeting in January of February. Aquatic Weed Control would attend and explain to residents why state funding is not available for these chemical treatments. The association should also monitor the lake to make sure that exotic weed species do not start to become a problem.

Cree Lake Chemical Application Cost Summary

Main Lake Action Plan

2005

Residents with lake frontages on the main lake should request to have lake frontages treated	$250.00 – $300.00 per lot

Channel Action Plan

2005

May – Herbicide Application to clear channel areas	$3,300.00
Early June – Herbicide application to clear channel areas	$3,300.00

* If residents decide to treat the channel only once, the treatment should take place in mid to late June to achieve maximum control.

Public Involvement and Education

An informational meeting was held by the Cree Lake Association on November 30, 2004. This meeting was held to inform residents about the problems facing Cree Lake. Potential solutions to these problems were discussed and Jim Donahoe of Aquatic Weed Control offered potential management strategies that could be used to control the native plant

species in the lake. A second public meeting will be held in January or February to discuss future plans to control the native plant species.

It is important that information about management practices on Cree Lake be made available to the public. Lake association meetings and newsletters are excellent avenues through which this information can be distributed. Informational signs could also be posted at lake access areas. Also, a summary of management practices funded by the LARE program would make an excellent addition to the annual fishing regulations guide and other IDNR publications. Additional information on aquatic management can be found at the following web sites: www.mapms.org www.aquatic.org www.apms.org www.nalms.org.

Monitoring and Evaluation of Plan

Although follow-up surveys are important for LARE funded projects aimed to control invasive species, they may not be essential in Cree Lake at this time. However, these surveys may be helpful to evaluate the effectiveness of management activities. After one year a survey can be conducted to determine if the treatment has reduced aquatic vegetation in problem areas of the lake. The lake residents will also provide valuable feedback about increased accessibility and utility of the lake. For those living on the lake, a reduction in weed growth should become evident in areas of the lake that were unusable before the chemical application.

Follow up surveys may be conducted on an "as needed" basis to document long-term changes in the abundances and distributions of both the native and the invasive plants in Cree Lake. Not only will this help protect the lake against the spread of invasive species, but it will also protect the native plants from being reduced to an unacceptable level. As stated before, the strategy is to reduce the native species, not eliminate them.

These surveys would provide the basis for evaluation of the management strategy and can be presented to the public should the need arise to modify the management strategy. They will also serve to keep the public interested and informed about Cree Lake so they will be motivated and equipped to help improve and conserve the quality of the Cree Lake ecosystem.

Another important part of the action plan will be to educate all lake users about the threat that invasive plants pose to Cree Lake. Signs may be posted at the public access site warning about the harmful effects of exotic species. Updates on the condition of the lake may be given through lake association newsletters or other publications as well. Also, a summary of projects made possible through LARE funding would be an excellent addition to the annual IDNR fishing regulations and other state publications.

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Appendix A: Aquatic Vegetation of Cree Lake

The following appendix was compiled using information found in the 5th edition of How to Identify Water Weeds and Algae, edited by James C. Schmidt and James R. Kannenberg.

1. Chara

Scientific name: *Chara sp*.
Classification: Native to Indiana
Distribution: Extremely common worldwide. Found in hard water.
Presence in Cree Lake: Collected at 37 of 60 sample sites

Description: Chara is often mistaken for a vascular plant, but it is actually an advanced form of algae. It can be gray, green or yellow in color and is usually forms extremely dense beds that may cover an entire lake. It can be identified by its distinct musky odor and calcium deposits on the algae's surface make it feel bristly to the touch. It possesses leaf-like structures that are whorled around the hollow stem, and it attaches its self to the lake bottom, although it has no actual roots. It usually grows in shallow, clear water.

2. Coontail

Scientific name: *Ceratophyllum demersum*
Classification: Native to Indiana
Distribution: Common throughout the U.S., usually in hard water.
Presence in Cree Lake: Collected at 22 of the 60 sample sites.

Description: Coontail plants are submersed and have no roots, though they appear to be attached to the lake bottom when viewed from above the surface of the water. The free-floating nature of coontail allows it to colonize new areas of a lake quickly, and it often times forms extremely dense weed beds where sufficient light and nutrients are available. Coontail has dark green leaves arranged in whorls around the stem and usually grows in long, bushy strands resembling evergreen trees beneath the surface of the water. Coontail's structure is very similar to Eurasian milfoil but coontail has forked leaves, which distinguishes it from the feather-like projections of milfoil leaves.

3. Naiad

Scientific name: *Najas minor* (brittle naiad)
Classification: Native to Indiana
Distribution: Common throughout the U.S.
Presence in Cree Lake: Collected at 7 of 60 sample sites

Description: The leaves of naiad plants are usually widest at the base and gradually become thinner near the tip of the leaf. Plants are extremely leafy and appear bush-like when viewed from above the surface of the water. Many species of naiad are very common in this area. Plant structure often resembles Chara, but the absence of calcium deposits on the surface of the plant help in identification. The leaves of brittle naiad have multiple spines along the margins that are visible to the naked eye.

4. Curley Leaf Pondweed

Scientific name: *Potamogeton crispus*
Classification: Exotic to Indiana
Distribution: Found throughout the U.S. in fresh and brackish water
Presence in Cree Lake: Collected at 6 of the 60 sample sites.

Description: Curley leaf pondweed usually grows and spreads rapidly in early spring and begins to dies out by midsummer as water temperatures approach 70 degrees Fahrenheit. Curley Leaf has extremely thin, membranous leaves arranged alternately on the stem with small teeth-like projections visible along the edge of each leaf. A reproductive spike may be seen protruding from the surface of the water. Curley leaf pondweed may also leave small reproductive structures called turions in the sediment on the lake bottom that can lie dormant throughout the winter and then sprout when spring arrives.

5. Illinois Pondweed

Scientific name: *Potamogeton illinoensis*
Classification: Native to Indiana
Distribution: Very widespread and very common throughout the U.S
Presence in Cree Lake: Collected at 4 of the 60 sample sites.

Description: Illinois pondweed is extremely common in Indiana, especially in the northern third of the state. This leafy weed has leaves with very broad bases that extend three-fourths of the way around the stem. The upper part of its slender stem is usually branched and very leafy.

6. Eel Grass (Wild Celery)

Scientific name: *Vallisneria americana*
Classification: Native to Indiana
Distribution: Found from the Great Plains to the East Coast of the U.S.
Presence in Cree Lake: Collected at 4 of the 60 sample sites.

Description: Eel grass has tufts of ribbon-like leaves with a horizontal stem embedded in the sediment connecting each tuft. This native plant grows thick weed beds anchored in the mud by roots. These dense beds often shade out other forms of weeds and provide excellent escape cover for small fish. The flowers of this plant are visible in late summer at sit on the top of a coiled structure protruding to the surface. This plant is found in both lakes and river, but is seldom found in stagnant systems. It is considered an extremely valuable plant to aquatic ecosystems.

7. Sago Pondweed

Scientific name: *Potemogeton pectinatus*
Classification: Native to Indiana
Distribution: Found throughout the U.S., Common in the northern 2/3 of IN.
Presence in Cree Lake: Collected at 3 of the 60 sample sites.

Description: Sago Pondweed has a bushy appearance with narrow, thread-like leaves that spread out to resemble a fan. Leaves are usually 1/16 of an inch wide and 1 to 6 inches long. Nutlets are formed on a string-like structure and protrude from the surface of the water. While sago pondweed can form dense beds, many times it is found in sparse, loosely distributed arrangements.

Appendix B: Tier II Data Sheets.

Table 5: Tier II Data Sheets

		Plants Present					
	CEDE4	POIL	CH?AR	NAFL	VAAM3	POPE6	POCR3
Site #	Coontail	Illinois Pondweed	Chara	Naiad	Eel Grass	Sago	Curly Leaf
1	1	1					
2	2		2				
3			5	1			
4			5				
5			5				
6			5				
7			5				
8	1				1	1	
9			5		1		
10			5				
11			5				
12			5				
13			5				
14	5						
15	1		5				
16			5	1			
17			2				
18			2	1			
19			5				
20			5				
21			5				
22			5				
23		1	5				
24			5				
25		1					
26							
27	1						
28	2						
29						1	1
30	3						
31	3						
32	3						1
33							

34	5						
35	1						
36	2						1
37	2						
38	2						
39	1					2	
40	1						1
41	1						1
42			5				
	CEDE4	POIL	CH?AR	NAFL	VAAM3	POPE6	POCR3
Site #	Coontail	Illinois Pondweed	Chara	Naiad	Eel Grass	Sago	Curly Leaf
43			5	2			
44			1				
45			5				
46			5				
47			5				
48			5				
49			5				
50			5				
51			5				
52	1		1	1	5		1
53	5				1		
54				5			
55			5				
56	3			1			
57			5				
58	1		5				
59			5				
60		1	1				

Appendix C: IDNR Tier II Survey Summary of Cree Lake

Table 6: IDNR Tier II Survey Summary of Cree Lake

Occurrence and Abundance of Submersed Aquatic Plants

Date:	7/27/04	Littoral sites with plants:	48	Species diversity:	0.70
Littoral depth (ft):	14.0	Number of species:	7	Native diversity:	0.68
Littoral sites:	50	Maximum species/site:	3	Rake diversity:	0.61
Total sites:	52	Mean number species/site:	1.40	Native rake diversity:	0.61
Secchi:	8.0	Mean native species/site:	1.36	Mean rake score:	3.84

Common Name	Site frequency	Relative density	Mean density	Dominance
Chara	52.0	2.06	3.96	41.2
Coontail	54.0	1.62	3.00	32.4
Curly-leaf Pondweed	4.0	0.04	1.00	0.8
Eel Grass	12.0	0.26	2.17	5.2
Northern Watermilfoil	2.0	0.04	2.00	0.8
Variable Pondweed	4.0	0.10	2.50	2.0
Naiad sp	12.0	0.12	1.00	2.4

Other Observed Plants
Spatterdock, Water lily, Purple Loosestrife, Cattail, Smartweed, Arrow Arum,